An Improved Measure of Risk Aversion

Sherman D. Hanna[1] and Suzanne Lindamood[2]

This study investigates financial risk aversion using an improved measure based on income gambles and rigorously related to optimal portfolio choices. The new measure modifies a previous measure by adding graphical presentations to clarify the impact of different income choices. We compared the measure's responses to those of previous non-graphical versions. To enable comparisons to an established risk measure, we also asked the Survey of Consumer Finances (SCF) risk tolerance question. Based on responses from 152 students, there is a significant correlation between relative risk aversion estimates based on the new measure and the SCF question.
Keywords: *Investments*, *Risk tolerance*, *Risk aversion*

Financial risk tolerance is an important aspect of investment decisions. The Certified Financial Planner Board lists client risk tolerance measurement and application as a topic planners should know and understand (CFP Board, 2004). There is no general agreement, however, as to which measure of risk tolerance is best or how to use risk tolerance measures to determine the appropriate portfolio allocation for each client. Understanding risk tolerance levels becomes even more important when considering the increasing individual investment choices for retirement funds and the ongoing discussion of individual choice for a portion of Social Security. Individuals who previously have not made investment choices will need to choose investments for retirement accounts and it is likely that they will not understand appropriate risk levels. There is the possibility that consumers who do not have familiarity with investments may be too conservative to make optimal choices or that they might equate taking risks as contrary to the concept of financial well-being. As more households will need to make investment choices in order to have an adequate retirement, measurement of risk tolerance becomes increasingly important.

The only rigorous theoretical analyses relating risk tolerance to optimal portfolios are based on the economic concept of risk aversion. The purpose of this article is to present an improved method of measuring risk aversion based on economic theory but presented in a graphical format to clarify the quantitative impact of options. The new measure is based on the Hanna, Gutter, and Fan (2001) pension-risk question, which modified a job-risk question used by Barsky, Juster, Kimball, and Shapiro (1997). This article presents the findings of a student survey using the new graphics-based method and compares those findings to studies that employed other methods of measuring risk

[1] Sherman D. Hanna, Professor, Consumer Sciences Department, The Ohio State University, 1787 Neil Avenue, Columbus, OH 43210. E-mail: hanna.1@osu.edu
[2] Suzanne Lindamood, Ph.D., J.D., Attorney, Columbus, OH. E-mail: Suzanne@lindamood.com

A previous version of this article won the Certified Financial Planner Board Award at the 2004 Academy of Financial Services meeting.

aversion, including the Survey of Consumer Finances risk question.

Literature Review

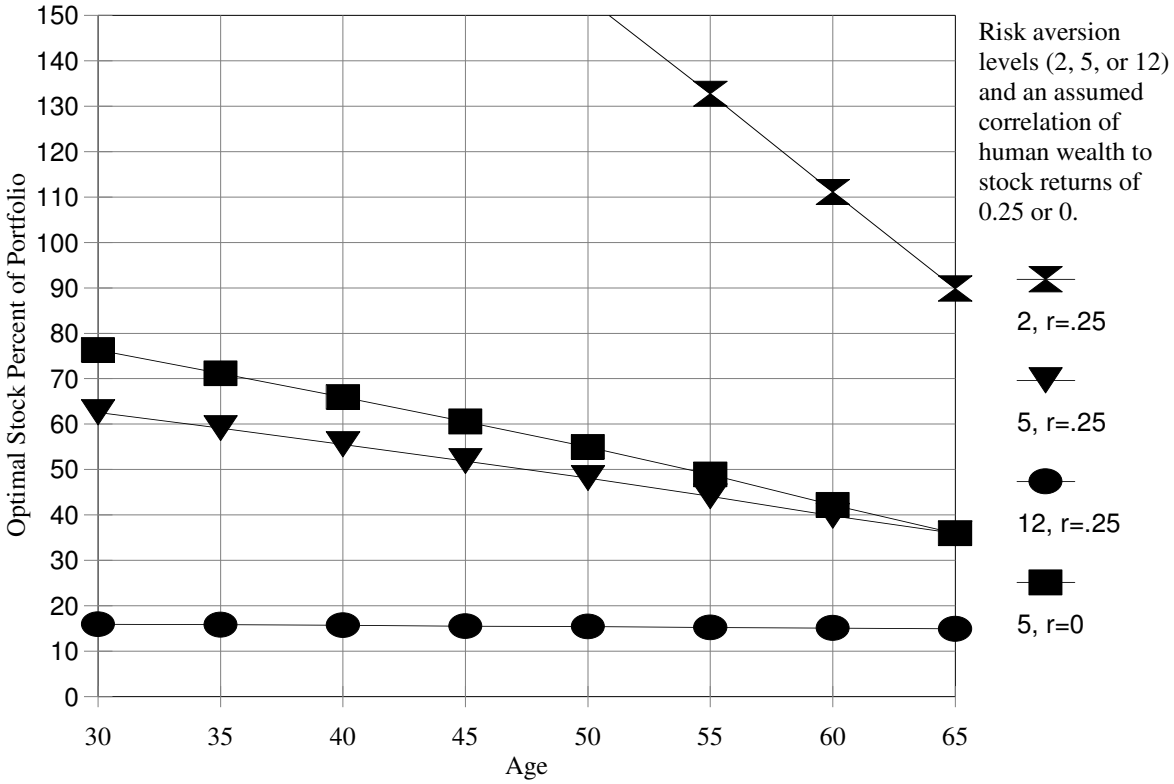
Prescribing Portfolio Allocations

The standard approach in economics for prescribing portfolio allocations is based on expected utility analysis. Modern portfolio theory is rooted in the expected utility approach, which compares the increased benefit of higher wealth if investments do well to the lost benefit of lower wealth if investments do poorly. It is plausible that households place a lower value on gains in wealth than they place on losses in wealth, meaning that everybody is somewhat risk averse.

Knowing a household's utility function enables an advisor to prescribe the best investment portfolio allocation based on past return patterns of different types of investments. A simple approach to relating optimal portfolios to expected utility theory is presented in Hanna and Chen (1997), who showed that even though the optimal retirement portfolio for typical young workers would be 100% stocks for a wide range of risk aversion levels, for older households the risk aversion level made a substantial difference in the optimal portfolio. Viceira (1999) and Campbell and Viceira (2002) presented more complex theoretical models that relate optimal portfolio allocations to relative risk aversion and lifecycle changes, including the relationship of human wealth to the investment portfolio. These concepts are the basis of Figure 1, a graph that summarizes the relationship between risk aversion and the optimal stock percent of a portfolio for each age. We created Figure 1 based on scenarios in a table in Viceira (1999) to illustrate the impact of relative risk aversion on optimal portfolio allocation. Representative scenarios included in Viceira's table are represented by lines in our graph. Each line represents a different risk aversion level — low (2), medium (5) or high (12) — and a correlation between human wealth and stock returns of either zero (r=0) or moderate (r=0.25). The graph illustrates that for an investor with low risk aversion (2) and with a correlation between human wealth and stock returns of 0.25, the optimal portfolio is more than 100% stocks (equivalent to buying on margin) until after age 50, only dropping below 100% after age 60. For an investor with moderate risk aversion (5) and a 0.25 correlation between human wealth and stock returns, at 35 years from retirement the optimal portfolio is 63% stocks. However, for a person at the same risk level (5) but with a zero correlation of human wealth and stock returns, the stock proportion at 35 years from retirement is 76%. For an investor with high risk aversion (12) and a 0.25 correlation between human wealth and stock returns, at 35 years from retirement the optimal portfolio is 16% stocks.

Figure 1

Optimal Portfolio Allocations by Relative Risk Aversion Level and Age



Created by authors based on results in Viceira (1999), Table 1. Each line represents a risk level scenario with an assumed relative risk aversion level of 2, 5, or 12, and an assumed human wealth to stock return correlation of either 0.25 or 0.0. Retirement is assumed to be at age 65.

Measuring Risk Aversion

As Figure 1 illustrates, risk aversion is extremely important in prescriptive models, though the relationship of the portfolio to other components of wealth, especially human wealth, is also very important (Hanna & Chen, 1997). One problem for financial advisors, however, is that aside from generally acknowledging that risk aversion is an important consideration, actually measuring risk aversion is not common and there has never been a direct survey of risk aversion for a sample of all adults in the United States.

Hanna, et al. (2001) observed that there are at least four methods of measuring risk tolerance: asking about investment choices, asking a combination of investment and subjective questions, assessing actual behavior, and asking questions based on hypothetical scenarios. They noted that inferring risk aversion based on observing actual portfolio allocations has many limitations, including the fact that many households have no portfolio to allocate so that nothing can be inferred about their risk aversion from their allocation. In this article, we focus on the approach that is based on asking hypothetical questions because it has the firmest link to the theoretical concept of risk aversion. We also discuss the approach based on asking about investment choices because it is the simplest method. A question using the investment choices approach has been asked in national surveys since 1983, and thus provides a basis for comparison.

Hypothetical Scenarios Based on Economic Models

Barsky et al. (1997) presented an experimental measure based on asking a set of hypothetical questions to a large national sample of adults aged 51 to 61. The measurement linked the theoretical concept of relative risk aversion to survey questions. Barsky et al. observed that risk tolerance could be considered the inverse of risk aversion. Their questions were similar to this initial one:

> Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50–50 chance it will double your (family) income and a 50–50 chance that it will cut your (family) income by a third. Would you take the new job?

Subsequent questions posed different percentage reductions in income. If the income cut percentage is denoted as (1- λ), by asking what percentage cut the respondent is willing to take, the measure essentially asks under what value of λ is the respondent willing to take the risk. If the respondent chooses to take the risk that could result in a cut in income, then based on expected utility theory, Barsky et al. show that Equation 1 must hold. The presentation below closely follows Barsky et al. (1997) and Hanna et al. (2001).

$$.5\ U(2C) + .5\ U(\lambda C) > U(C) \quad (1)$$

For a constant relative risk aversion utility function, Equation 2 below shows the relationship between relative risk aversion *A* and λ:

$$\lambda = (2 - 2^{(1-A)})^{[1/(1-A)]} \quad (2)$$

Equation 2 holds if $A \neq 1$, and $\lambda = 0.5$ when $A=1$. Therefore, by asking questions with different levels of λ, relative risk aversion can be directly calculated. For instance, if one is indifferent between the current job and the new risky job with a 50-50 chance of either doubling income or a one-third cut, then $1-\lambda = 0.3333$ and relative risk aversion must equal 2.0.

Table 1 shows the relationship, under the Barsky assumptions, between the largest cut in pay a respondent would risk in order to have a 50% chance of doubling income and the relative risk aversion related to that choice. Note that with these assumptions, a risk neutral person (relative risk aversion = 0) would be willing to accept a 50% chance of zero income, even though the implicit assumption is that zero income would mean death, because there would be no other income.[a] As it is unlikely that someone would find this outcome acceptable, it is therefore plausible that all rational consumers are risk averse to some degree.

Table 1 also shows, for a job with a guaranteed income of $50,000 per year, the expected value of the alternative risky job, assuming a 50% chance of $100,000 per year and a 50% chance of a lower income. For a consumer not willing to accept a chance of even a slight reduction of income, relative risk aversion would be infinite. With this model, a consumer who is willing to accept a 50% chance of cutting income in half in order to have a 50% chance of doubling income has a relative risk aversion of no greater than 1.0, a very low level of risk aversion. A consumer willing to accept only a 33.3% chance of a 50% reduction of income in order to have a 50% chance of doubling income has a relative risk aversion of no more than 2.0 (low risk aversion). A consumer willing to accept only a 50% chance of a 5% reduction

of income in order to have a 50% chance of doubling income has a relative risk aversion of no more than 14.5 (high risk aversion). A consumer *not* willing to accept a 50% chance of a 5% reduction of income in order to have a 50% chance of doubling income has a relative risk aversion of more than 14.5 (extremely high risk aversion).

Table 1
Relative risk aversion levels based on hypothetical income gambles

λ	1- λ (% reduction possible)	A (relative risk aversion)	Income if reduced	Expected value of risky job (per year)
0.0%	100.0%	0.00	$0	$50,000
50.0%	50.0%	1.00	$25,000	$62,500
66.7%	33.3%	2.00	$33,333	$66,667
75.6%	24.4%	3.00	$37,796	$68,898
80.0%	20.0%	3.76	$40,000	$70,000
84.0%	16.0%	4.76	$42,006	$71,003
86.8%	13.2%	5.76	$43,398	$71,699
88.8%	11.2%	6.76	$44,405	$72,203
90.0%	10.0%	7.53	$45,000	$72,500
90.6%	9.4%	8.00	$45,312	$72,656
92.0%	8.0%	9.29	$46,000	$73,000
93.5%	6.5%	11.29	$46,746	$73,373
94.5%	5.5%	13.29	$47,259	$73,630
95.0%	5.0%	14.51	$47,250	$73,750

Calculated by the authors, based on Barsky et al. (1997).
Each gamble offers a guaranteed income of $50,000 per year or equal chances of doubling that income or reducing it by a specified percent. Doubling is $100,000 for each scenario. The expected value of the risky job is the average of possible high and possible low income if the 50-50 gamble is chosen.

Using a sample of 11,707 respondents age 51 to 61, Barsky et al. (1997) found that 64.6% had a relative risk aversion level *(A)* between 3.76 and infinity (moderate to high risk aversion), 11.6% had a value between 2 and 3.76 (moderately low risk aversion), 10.9% had a value between 1 and 2 (low risk aversion), and 12.8% had a value between 0 and 1(very low risk aversion). Hanna et al. (2001) observed that while Barsky's measure was theoretically sound, it had at least three potential defects: the measure was ambiguous about income taxes, it failed to provide distinctions for higher levels of risk aversion, those above 3.8, and it did not specify the alternatives. Hanna et al. (2001) concluded that it was essential that respondents consider that the scenario's hypothetical income decreases are permanent, so they developed an alternative set of questions based on pension choices rather than jobs, and clarified that there could be no other source of income. In 1998, they posted the pension choice questions on a web page and allowed undergraduates to answer the questions for extra credit. They also promoted the web survey to adults by news releases and emails to professional organizations. There were 390 usable responses with an age range of 19 to 57 and a mean age of 25. About 59% of the respondents were male.

Hanna et al. (2001) compared the results for their pension choice measure to the Barsky et al. (1997) results. With the Barsky measure, 24% of the respondents had an estimated relative risk aversion level of less than 2, which implies extremely risky portfolio behavior, applying the Viceira (1999) results previously discussed. The Hanna et al. web survey results show that only 6% of their respondents had an estimated relative risk aversion level less than 2. In the Barsky survey, 65% of the respondents had a relative risk aversion level of 3.8 or higher, though it is not possible to differentiate among levels higher than 3.8, which is a shortcoming when considering the high percentage of respondents above that level. The Hanna et al. web survey results, capturing a wider range of responses, found that 72% had a relative risk aversion level of 3.8 or higher and 11% had a relative risk aversion level of 14.5 or higher.

The hypothetical income choices in both Barsky et al. (1997) and Hanna et al. (2001) may have been too complex for many respondents to fully understand. The Barsky result, that 24% of respondents aged 51 to 61 had very low aversion to risk (levels less than 2), seems implausible given the implication that they should have very risky portfolios. At the same time, the Hanna et al. result that 11% of a younger sample of respondents had very high relative risk aversion levels also seems implausible.

Investment Choice Measures

A good example of the *investment choice* method of determining risk aversion is the risk question asked as part of the Survey of Consumer Finances (SCF) sponsored by the Federal Reserve Board every three years from 1983 to 2001. Starting with the 1983 survey, the same question on financial risk tolerance has been asked in each survey except 1986. The SCF question is the only risk tolerance question that has been asked of a national sample representing all adults

over a long period of time. The question asks which level of risk the respondent is willing to take when saving or making investments: substantial risk expecting to earn substantial returns, above average risk to earn above average returns, average risk expecting to earn average returns, and not willing to take any financial risks. In the 2001 SCF, a relatively low proportion of respondents, about 23%, had substantial or above average levels of risk tolerance while 40% said they were not willing to take any risk (Yao, Hanna, & Lindamood, 2004).

Although the SCF risk tolerance measure is widely used by researchers, its validity has not been specifically tested for use in the SCF.[b] Its validity is indicated, however, by the findings of several researchers. Gutter, Fox, & Montalto (1999) found a consistent relationship between being willing to take risk and holding risky assets for 66% of households in the 1995 survey. Grable and Lytton (2001) concluded that the SCF question is valid in terms of face validity and construct validity, that it offers a reasonable measure of reliability, and it is useful for research on investment risk tolerance. They reported a 0.54 correlation between the SCF measure and their own risk tolerance measure in a sample of university employees. However, they pointed out that in terms of concurrent validity, the correlation between the SCF measure and other measures of risk tolerance, "more empirical research is needed to fully explore issues related to the validity of the SCF question."

Hanna et al. (2001) obtained responses to the SCF investment risk tolerance question in their online survey and found that only 11% chose the *no risk* response, compared to 40% in the 2001 national Survey of Consumer Finances (Yao, et al. 2004). Hanna et al. (2001) also reported that there was not a significant correlation between the SCF risk measure and the pension risk aversion results.

Purpose

The purpose of this article is to test an improved version of the Hanna et al. pension choice measure of risk aversion and relate responses to that measure to the SCF risk aversion measure. As discussed in this article, both the Barsky et al. (1997) risk questions based on hypothetical job choices and the Hanna et al. (2001) risk questions based on hypothetical pension choices may have been too complex for many people to understand. Both sets of questions required respondents to keep many numbers and percentages in their minds in order to reach appropriate choices, making it plausible that many of the responses did not really measure risk aversion. Our improved pension choice questions include graphical illustrations to represent the quantity of the increase or decrease in the pension to increase the chance that respondents understand the impact of the hypothetical alternatives and more accurately relate their true risk level.

The new measure has implications for issues such as explanation of the equity premium puzzle and appropriate risk tolerance measures for financial planners. For instance, many rigorous analyses of optimal portfolio allocations are either implicitly or explicitly based on risk aversion (Campbell & Viceira, 2002).

Data and Methods

We developed the new, graphic-based survey instrument based on the Hanna et al. (2001) pension choice questions. We edited the wording and added graphical illustrations, thereby reducing the need for a respondent to manipulate numbers. The instrument is shown in the Appendix. In addition to the series of pension choice questions, the survey included the SCF Investment Risk question for comparison purposes, and also the age and sex of the respondent. Students in two personal finance classes at Ohio State University completed the online survey in January, 2004, and the analyses were performed on 152 valid responses. Correlations were obtained to determine the relationship between the graphic-based pension measure and the SCF risk measure as well as between each measure and gender.

Results and Discussion

The respondents in the student sample were primarily male (74%) and young, with an age range of 21 to 44 and a mean age of 23. The mean level of risk aversion was 4.4, with 18% having a risk aversion level less than 2.0, and 4% having a risk aversion level of 9.3 or higher. Most respondents had risk aversion levels consistent with an all stock retirement portfolio until middle age, then stock allocations decreasing to about 40% by retirement, based on Figure 1 and also in Hanna and Chen's analysis (1997).

Table 2 and Figure 2 compare the relative risk aversion levels based on three surveys: the graphic-based student survey, the Barsky et al. (1997) national sample of adults age 51 to 61, and the 1998 Hanna web survey (Hanna, et. al. 2001). The student respondents to the new graphic-based pension risk questions had a lower mean level of risk aversion (mean = 4.4) than the

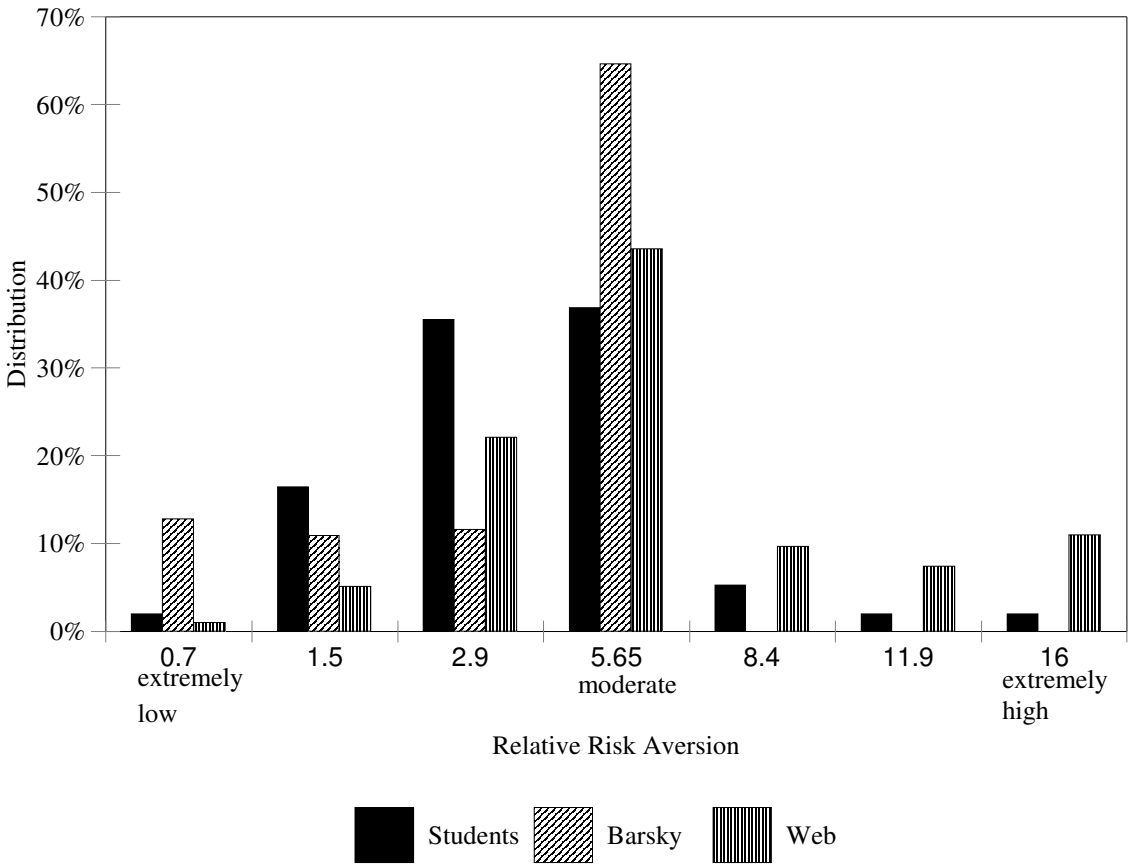
previous web survey respondents with the non-graphic pension questions (mean = 6.6), but higher mean risk aversion than the older adults in the Barsky survey with the jobs question (mean = 4.1). Over 18% of the students, compared to 24% in the Barsky question and 6% in the Hanna web survey, had estimated risk aversion levels under 2. The student respondents were less likely than the web survey respondents to have high risk aversion levels of 7.5 or higher, with 9% of the students being in one of the high risk aversion categories compared to 28% of the web respondents.

Table 2
Risk Aversion Levels Based on Hypothetical Income Choice Questions in Three Surveys

Risk Aversion Level*	**Hanna & Lindamood Student Survey****	**Barsky et al. Survey†**	**Hanna et al. Web Survey‡**
		----------percent distribution----------	
Extremely Low Risk Aversion (A< 1.0)	2	13	1
Very Low Risk Aversion (1.0 ≤ A < 2.0)	16	11	5
Moderately Low Risk Aversion (2.0 ≤ A < 3.8)	36	12	22
Moderate Risk Aversion (3.8 ≤ A < 7.5)	37	65	44
High Risk Aversion (7.5 ≤ A < 9.3)	5		10
Very High Risk Aversion (9.3 ≤ A ≤ 14.5)	2		7
Extremely High Risk Aversion (A > 14.5)	2		11
Mean Relative Risk Aversion	4.4	4.1	6.6

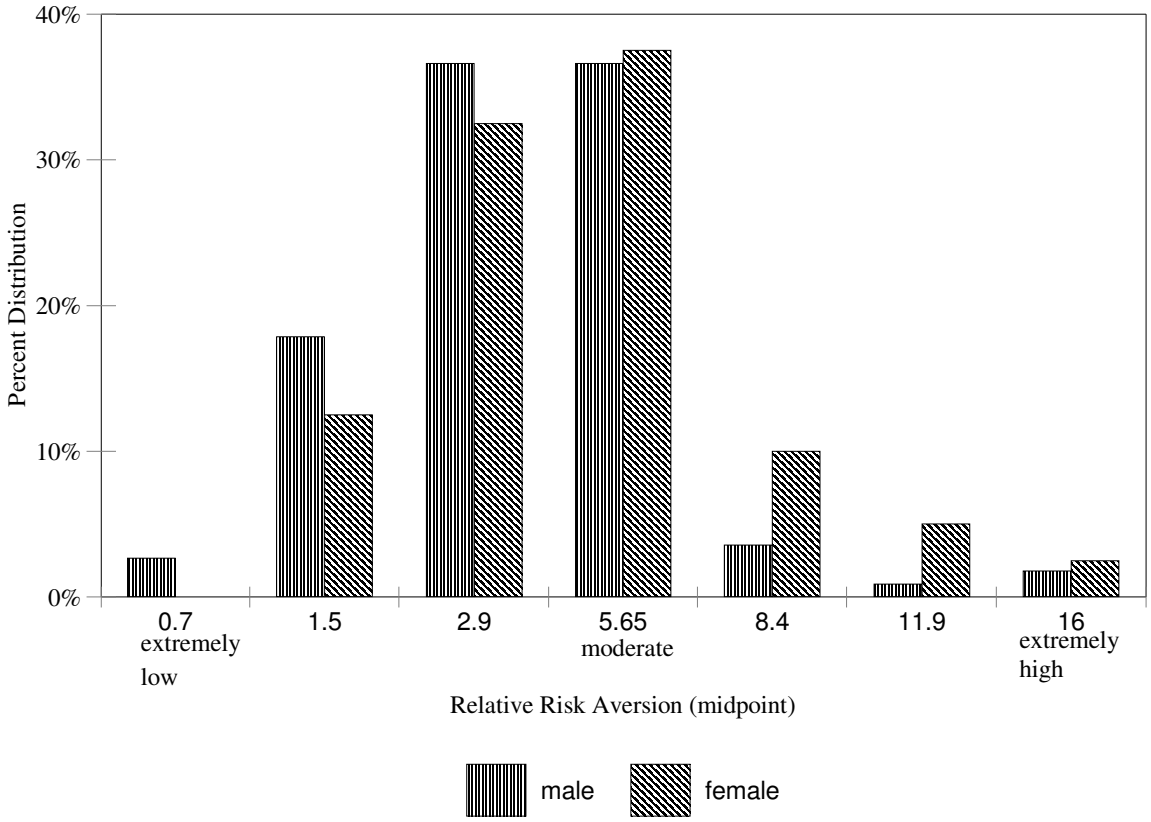
*Lower Risk Aversion = Higher Risk Tolerance
A = Risk Aversion Level
** Graphic pension question in *Student Survey*, using the Hanna & Lindamood graphic-based pension question, conducted in two personal finance courses in 2004 at Ohio State University, N = 152.
† Barsky job question is based on the Job Income Risk question in the *Barsky* et al (1997) survey of 11,707 adults age 51-61. Barsky did not differentiate between levels of risk aversion above 3.8.
‡ Pension question in *Web Survey* conducted in 1998. Results based on Hanna, et al. (2001), N= 390.

Figure 2
Risk Aversion Levels Based on Hypothetical Income Choice Questions in Three Surveys



Web Survey conducted in 1998, used the Hanna pension question , Hanna, et al. (2001), N= 390 .
Student Survey used the Hanna & Lindamood graphic-based pension question and was conducted in two personal finance courses in 2004 at Ohio State University, N = 152.
Barsky is based on the Job Income Risk question in the Barsky et al, 1997, survey of 11,707 adults age 51-61. Barsky did not differentiate between levels of risk aversion above 3.8.

Figure 3
Relative Risk Aversion by Gender
Hanna & Lindamood Student Survey, Graphic-based Pension Choice Question



Student Survey conducted in 2004 with students in two personal finance courses at Ohio State University, N = 152.
Web Survey conducted in 1998, reported in Hanna, et al. (2001).
2001 SCF is based on responses in the 2001survey, weighted analysis, reported in Yao et al. (2004).

Gender differences also emerged in the student responses to the graphic-based pension choice question, with males being less risk averse than females (Figure 3). The mean level of relative risk aversion was 4.1 for males and 5.1 for females. None of the females had extremely low risk aversion, but almost 3% of males had extremely low risk aversion, corresponding to a relative risk aversion level of less than 1.0. Males and females had fairly similar responses in the middle ranges of risk aversion, but females were more likely than males to be in the high relative risk aversion levels.

Correlation analysis was performed to test the significance of the male-female differences in risk in the student responses for both the graphic-based risk measure and the SCF risk measure. The correlations show that gender has a positive relationship to the risk measures, indicating that females are more risk averse than males. The SCF risk tolerance measure (reverse coded so substantial risk tolerance is equal to low risk aversion) is significantly correlated with being female (p=0.002) while the correlation of the graphic-based relative risk aversion measure and gender is significantly different from zero only at the 0.045 level. (Table 3).

SCF Risk Tolerance Question

The Survey of Consumer Finances risk tolerance question provides a basis to compare the risk tolerance level of the student respondents to respondents in other surveys. The students in our 2004 survey were much more likely than both the 2001 national sample and the Hanna web survey to be willing to take substantial risk (16% compared to 5% and 7%, respectively) and much less likely to be unwilling to take any risk, with only 1% of the students not willing to take risk compared to 40% in the SCF and 11% in the web survey. Table 4 and Figure 4 show the responses to the SCF question in the three surveys – the 2004 student survey, the 1998 web survey, and the 2001 SCF.

Table 3
Correlations in Hanna and Lindamood Student Survey

Variable	**Relative Risk Aversion** (Revised pension choice)	**Gender** (1= female, 0= male)
Investment Risk Aversion (SCF measure)*	0.3799 ($p < 0.0001$)	0.2526 (p=0.002)
Relative Risk Aversion (Revised pension choice)		0.1628 (p=0.045)

Based on 2004 survey of 152 students at Ohio State University
Responses to the SCF risk question and the graphic-based pension risk question.
*The SCF risk tolerance measure is coded so that 1=high risk tolerance (low risk aversion) and 4=low risk tolerance (high risk aversion.)

Figure 4
Risk Aversion Levels Based on the SCF Investment Risk Tolerance Question in Three Surveys

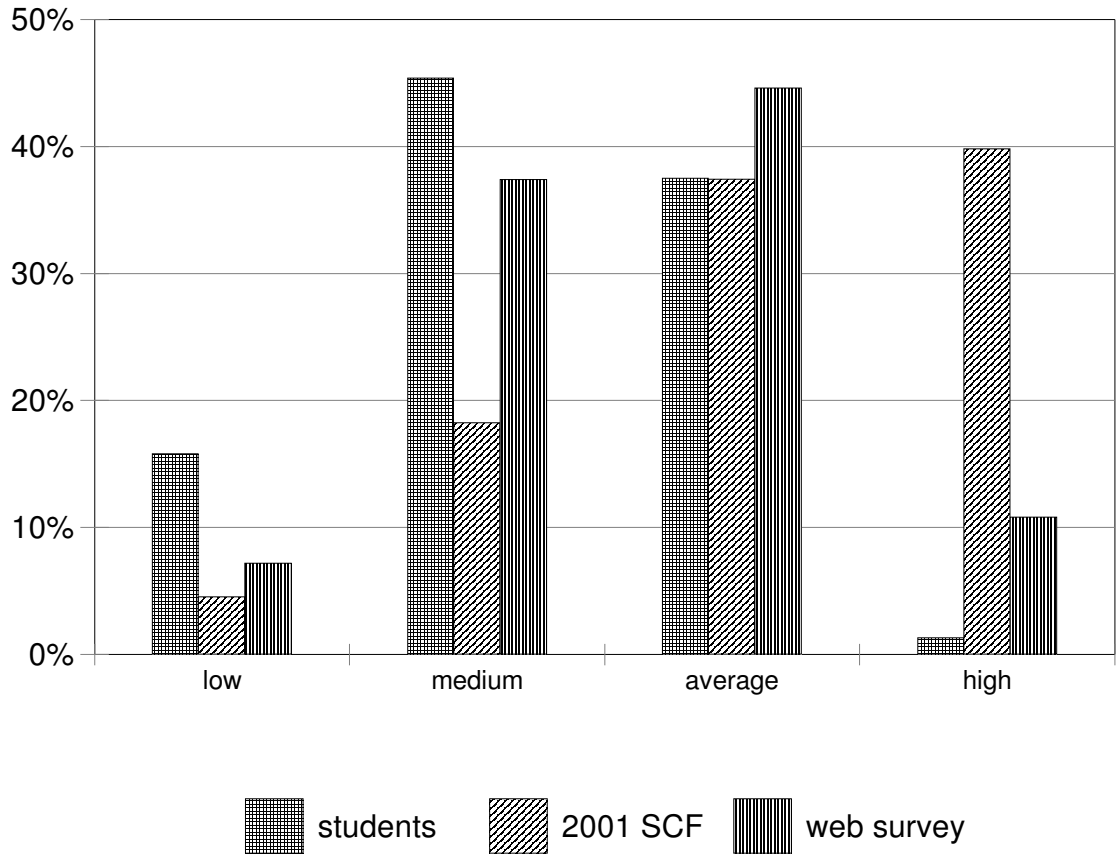


Table 4
Risk Tolerance Levels Based on the SCF Investment Risk Tolerance Question in Three Surveys

Risk Tolerance Level*	Hanna & Lindamood Student Survey**	2001 SCF†	Hanna et al. Web Survey‡
	percent distributions		
Substantial	16	5	7
Above Average	45	18	37
Average	38	37	45
No Risk	1	40	11

* Higher Risk Tolerance = Lower Risk Aversion
** SCF question given in *Student Survey*, conducted in two personal finance courses in 2004 at Ohio State University, N = 152.
† *2001 SCF* is based on responses in the 2001 survey, weighted analysis, reported in Yao et al. (2004).
‡ SCF question given in *Web Survey* conducted in 1998, reported in Hanna, et al. (2001).

It is desirable in developing a new measure to compare that measure's results to the results of other measures of the same concept (Grable & Lytton, 2001). We created the graphic-based pension question as an improved measure of risk aversion. The measure is rooted in economic theory, being based on the hypothetical income choice approach to measuring risk used in the Barsky job-choice question and the Hanna pension-choice question. While measures based on the Barsky et al. (1997) income gambles are the only measures of risk based in economic theory, none has been used in a national sample of adults of all ages. The SCF measure is the only measure of financial risk included in a national survey for a sample of all adults over many years, and therefore we compare the results obtained from the new graphic-based measure to the SCF.

We performed two types of analyses to compare the results from our new graphic-based income gamble measure to the SCF results: correlation to test whether the relationship is significantly different than zero, and regression of the graphic-based relative risk aversion estimate on the SCF risk measure.

Both the correlation and the regression analysis show a very strong relationship between the new measure of risk and the SCF measure of risk tolerance (Table 3). The correlation of the graphic-based pension choice method and the SCF measure is a highly significant correlation of 0.38.
The regression results are:
A = 1.38001 + 1.330611 S
where A is relative risk aversion, and S is the answer to the SCF investment risk aversion question, with "substantial" = 1 and "no risk" = 4. The t-value for the coefficient of S is 4.566156 (p = 0.00001).

If the prediction equation is applied to the distribution of responses in the 2001 Survey of Consumer Finances, as reported in Yao et al. (2004) and shown in Table 4, the mean level of relative risk aversion in the U.S. population would be approximately 5.5. It is possible that the relative risk aversion level could be higher, considering the limited number of "no risk" responses in our student sample, but it is plausible that the level is at least that high.

Discussion and Conclusions

This is the first research to show a significant positive correlation between the SCF Investment Risk Aversion measure and relative risk aversion as measured by hypothetical income gamble questions. Hanna et al. (2001) did not find a significant correlation between the two measures in their sample. The correlation found in the present research and the more reasonable results on extremely high and low relative risk aversion responses make it plausible that the graphical presentation of the hypothetical pension choices increases the chance that a respondent will understand the hypothetical choices and give a response more related to his or her true relative risk aversion.

Given the need to use a measure of relative risk aversion that takes advantage of rigorous portfolio prescriptions, such as presented by Campbell and Viceira (2002), it is useful to have a valid and reliable measure. However, the SCF question may be a reasonable substitute for the much more complex set of hypothetical pension choice questions (shown in the Appendix). Conversion of "above average" to a relative risk aversion level of 4 and an "average" risk response to a relative risk aversion level of 5.5 might be plausible, though certainly these are not conversions that can be made with confidence based on the student sample used. One should even more cautious in converting the "substantial" and "no risk" responses into risk aversion levels.

It would be desirable to repeat this survey with a larger, more diverse sample. The increasing importance of making investment recommendations before and after retirement makes recommendations based on the best possible measures of relative risk aversion of great importance.

Endnotes

a. The implicit assumption for Barsky's hypothetical choices is that no other source of income would ever be available, though it is not clear that respondents to the Barsky et al. (1997) questions understood that.
b. As reported in Yao, et al. (2004), according to Arthur Kennickell, project director of the Survey of Consumer Finances, the SCF investment risk tolerance question was suggested by Marshall Blume of the Wharton School, University of Pennsylvania (Arthur Kennickell, personal communication, April 28, 2003). According to Blume, the question was developed by the New York Stock Exchange (Marshall Blume, personal communication, April 29, 2003). Neither Blume nor Kennickel recall any academic studies justifying or validating the risk tolerance measure.

References

Barsky, R. B. , Juster, F. T., Kimball, M. S. & Shapiro, M. D. (1997). Preference parameters and behavioral heterogeneity: An experimental approach in the Health and Retirement Study, *Quarterly Journal of Economics*, *112* (2), 537-579.

Campbell, J. Y. & Viceira, L. M. (2002*). Strategic asset allocation,* Oxford University Press.

Certified Financial Planner Board (2004) *CFP Board Topic List for CFP® Certification_Examination*, retrieved 2/22/2004 from http://www.cfp.net/downloads/guide_FPTopics.pdf

Grable, J. E. & Lytton, R. H. (2001). Assessing the concurrent validity of the SCF risk tolerance question. *Financial Counseling and Planning, 12* (2), 43-52.

Gutter, M.S., Fox, J.J., & Montalto, C.P. (1999). Racial differences in investment decision making, *Financial Services Review*, 8, 149-`62.

Hanna, S. & Chen, P. (1997). Subjective and objective risk tolerance: Implications for optimal portfolios. *Financial Counseling and Planning, 8* (2), 17-26.

Hanna, S. D., Gutter, M. S., & Fan, J. X. (2001). A measure of risk tolerance based on economic theory. *Financial Counseling and Planning, 12* (2), 53-60. Available at: http://hec.osu.edu/people/shanna/hanna012.htm

Viceira, L.M. (1999). Optimal portfolio choice for long-horizon investors with nontradable labor income. Working Paper 7409. *NBER Working Paper Series*. National Bureau of Economic Research: Cambridge, MA.

Yao, R., Hanna, S. D., & Lindamood, S. (2004). Changes in financial risk tolerance, 1983-2001. *Financial Services Review*, 13 (4), in press.

Appendix
Risk Tolerance Questions Answered by 152 Students

Risk Tolerance Questions: Investment Risk Tolerance and Subjective Risk Tolerance

Gender: Male Female
Age = _____

Investment Risk Tolerance

Note – All students participating in this survey saw the online version, which included graphs with color. The online version of the following questions, used for the results reported in this article, is available at:

http://hec.osu.edu/people/shanna/rts/

Which of the statements below comes closest to the amount of financial risk that you are willing to take when you save or make investments? Circle one.

1. Substantial financial risks expecting to earn substantial returns.
2. Above-average financial risks expecting to earn above-average returns.
3. Average financial risks expecting to earn average returns.
4. No financial risks.

Subjective Risk Tolerance Questions

1. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

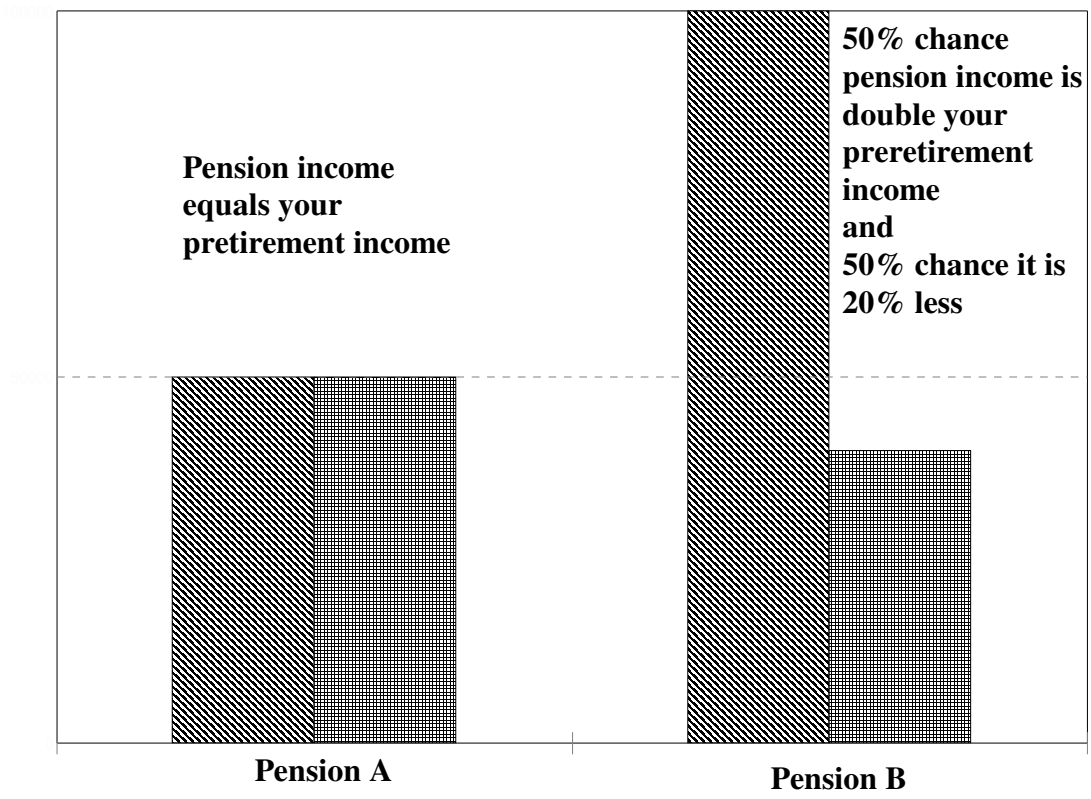
Pension B has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **20%** less than your preretirement income.

You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, go to #2.
If B, go to #5.



2. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

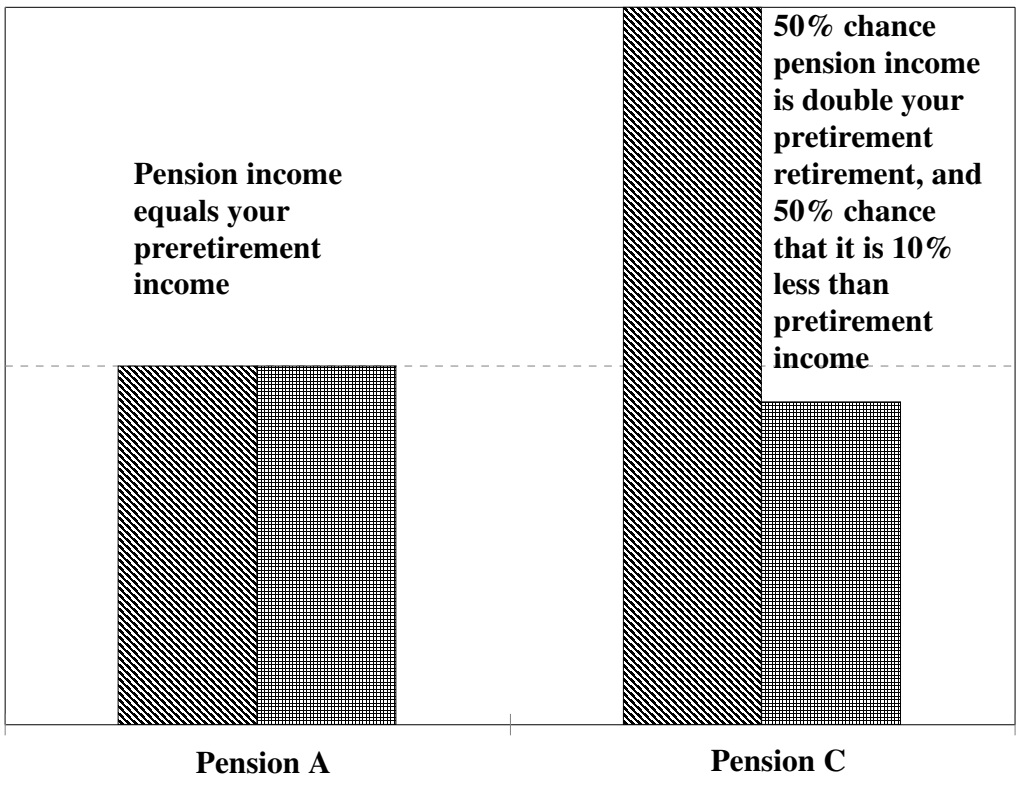
Pension C has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **10%** less than your preretirement income.

You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, go to #3 on the next page
If C, your subjective risk tolerance is **Moderate**



3. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

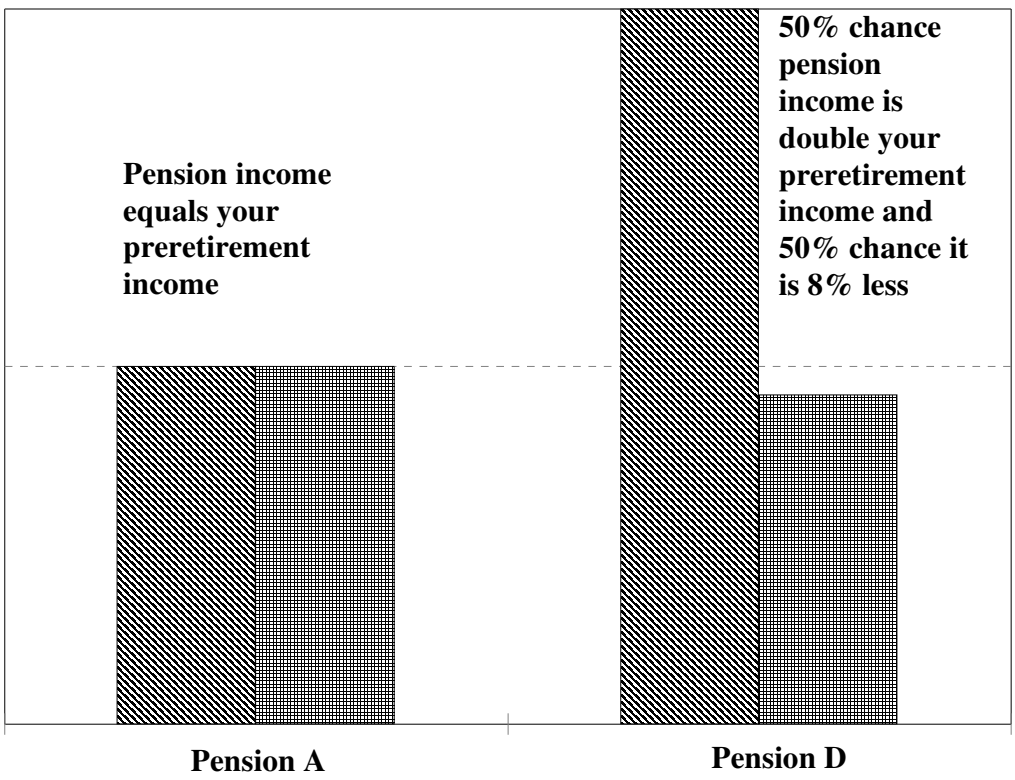
Pension B has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **8%** less than your preretirement income.

You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, go to #4
If D, your subjective risk tolerance is **Low**



4. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

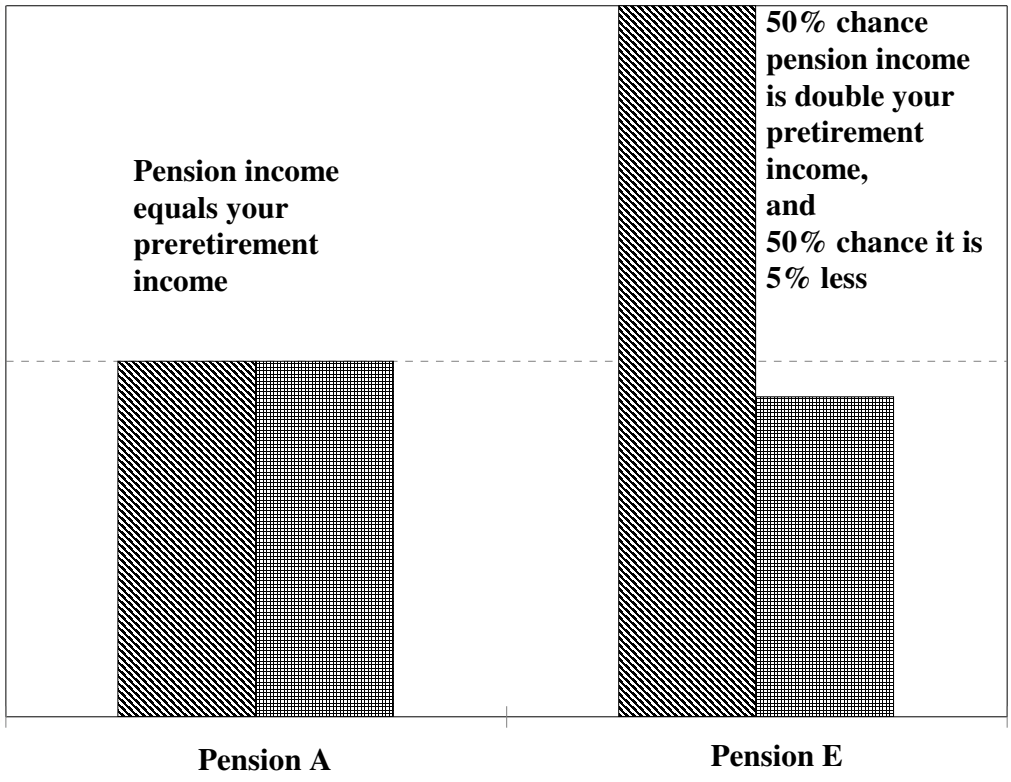
Pension E has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **5%** less than your preretirement income.

You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, your subjective risk tolerance is **Extremely Low**
If E, your subjective risk tolerance is **Very Low**



5. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

Pension F has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **one third** less than your preretirement income.

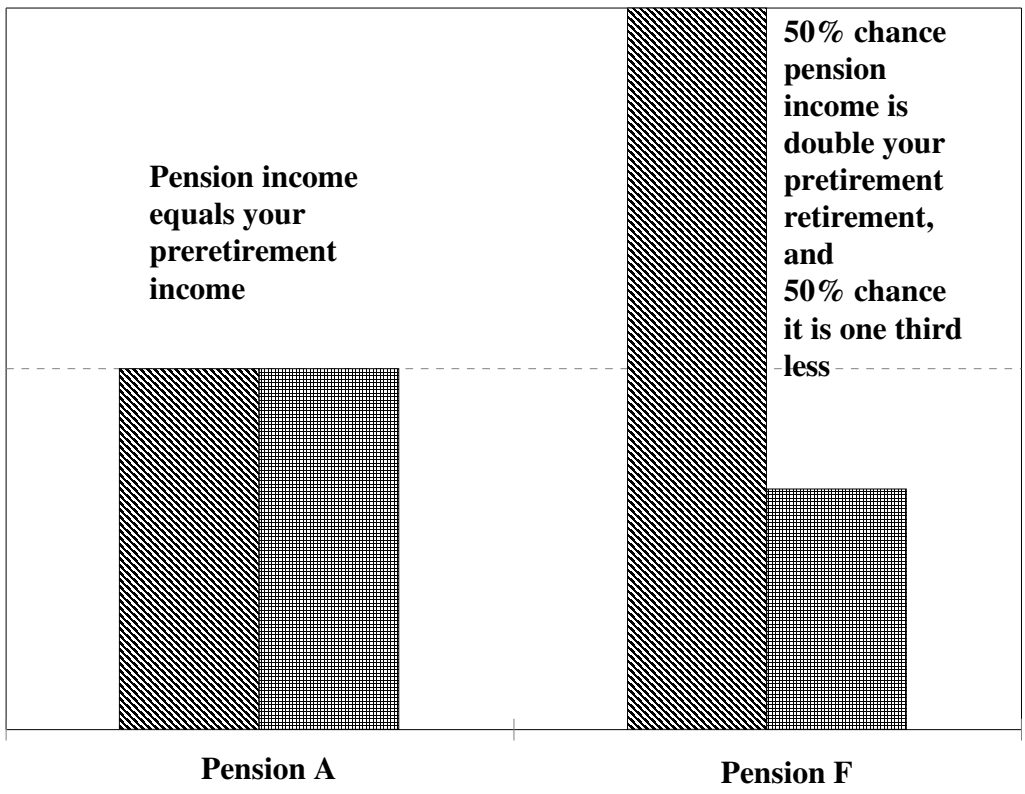
You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, your subjective risk tolerance is **Moderately High**

If F, go to #6



6. Suppose that you are about to retire, and have two choices for a pension

Pension A gives you an income equal to your preretirement income.

Pension G has a 50% chance your income will be double your preretirement income, and a 50% chance that your income will be **half** of your preretirement income.

You will have no other source of income during retirement, no chance of employment, and no other family income ever in the future.

All incomes are aftertax.

Which pension would you choose?

If A, your subjective risk tolerance is **Very High**

If G, your subjective risk tolerance is **Extremely High**